

C11. CHAPTER 11  
TOXIC CHEMICAL MUNITIONS AND AGENTS

C11.1. SCOPE AND APPLICABILITY

C11.1.1. This chapter sets forth standards for protecting workers and the general public from the harmful effects of toxic chemical munitions and agents associated with research, testing, training, preservation and maintenance operations, storage, and demilitarization at laboratories, manufacturing plants, and depots as well as other DoD Component agent operations, exclusive of combat training and operations. They apply to:

C11.1.1.1. Blister agents (examples include, but are not limited to):

C11.1.1.1.1. H/HD – 2,2' Dichlorodiethyl Sulfide (common name is distilled mustard).

C11.1.1.1.2. H/HT – 60 percent HD and 40 percent 2,2' Dichloroethylthiodiethyl Ether (common name is mustard-T mixture).

C11.1.1.1.3. L – Dichloro (2-chlorovinyl) Arsine (common name is Lewisite).

C11.1.1.2. Nerve agents (examples include, but are not limited to):

C11.1.1.2.1. GB – Isopropyl Methylphosphonofluoridate (common name is sarin).

C11.1.1.2.2. GA – Dimethylaminoethoxy-cyanophosphine Oxide (common name is tabun).

C11.1.1.2.3. VX – 0-ethyl S-[2-(diisopropylamino) Ethyl] Methylphosphonothioate.

C11.1.1.2.4. GD – Pinacolyl Methylphosphonofluoridate (common name is soman).

C11.1.1.2.5. Mixtures of these agents.

C11.1.2. Toxic chemical munitions may present additional hazards of blast, fragments, and thermal effects. Standards relating to these explosives hazards are addressed in other chapters.

C11.1.3. This standard does not apply to the immediate disposal of toxic chemical munitions or decontamination of toxic chemical agents during an emergency when the delay will cause a greater danger to human life or health.

C11.1.4. The DoD Components are responsible for developing implementing instructions and safety procedures for logistical movements, training, and field operations.

C11.1.5. The requirements of MIL-STD-882D (Reference (~~abad~~)) shall be followed.

## C11.2. SITING CRITERIA

C11.2.1. Hazard Distance Calculations (See Public Exclusion Distance). Hazard distance calculations shall conform to Reference (qs). DDESB approved software (e.g., D2PC (Reference (aeae))) that implements the methodology of Reference (qs) may be used to perform these calculations. The calculated hazard distance is based on the greater of the MCE or the toxic chemical agent MCE and is bounded by the one percent lethality arc for a toxic chemical agent source containing a dose of more than:

C11.2.1.1. 10.0 mg-min/m<sup>3</sup> of GB.

C11.2.1.2. 4.3 mg-min/m<sup>3</sup> of VX.

C11.2.1.3. 150.0 mg-min/m<sup>3</sup> mustards.

C11.2.1.4. 0.1 mg for inhalation-deposition of VX.

C11.2.2. Positive means shall be taken to ensure that unprotected personnel do not enter hazard zones and shall include written procedures that must be reviewed and updated, as necessary. However, positive control of an area, which ensures personnel can evacuate or be protected before exposure in the case of an accident, may be developed instead of absolute exclusion. Details of such control procedures shall be included in the site and general construction plans.

## C11.3. WORKPLACE AIRBORNE EXPOSURE LIMITS (AEL)

The Army Surgeon General establishes the maximum permissible concentrations (AEL) listed in Table C11.T1. AEL are time-weighted averages (TWA) or ceiling values that define the permissible limits of exposure for unprotected personnel.

Table C11.T1. Airborne Exposure Limits

	Chemical Agents (mg/m <sup>3</sup> )				
	GD	GA/GB	VX	H,HD,HT	L (Note 1)
Unmasked Agent Worker					
8-hour TWA in any work shift	$3 \times 10^{-5}$	$1 \times 10^{-4}$	$1 \times 10^{-5}$	$3 \times 10^{-3}$ (Note 2)	$3 \times 10^{-3}$ (Note 2)
Non-agent Worker and General Population					
72-hour TWA	$3 \times 10^{-6}$	$3 \times 10^{-6}$	$3 \times 10^{-6}$	$1 \times 10^{-4}$ (Note 3)	$3 \times 10^{-3}$ (Note 2)
Ceiling Value (Note 4)	$3 \times 10^{-5}$	$1 \times 10^{-4}$	$1 \times 10^{-5}$	$3 \times 10^{-3}$ (Note 2)	$3 \times 10^{-3}$ (Note 2)
Source Emission Limit					
1-hour TWA	$1 \times 10^{-4}$	$3 \times 10^{-4}$	$3 \times 10^{-4}$	$3 \times 10^{-2}$	$3 \times 10^{-2}$

Notes for Table C11.T1.:

1. All concentrations measured as Lewisite.
2. This value also represents the technologically feasible real time detection limit. HT is measured as HD.
3. It is recommended that this level of detection (using a 12-hour sampling time) be demonstrated and used at all sites where mustard shall be transported and destroyed.
4. The concentration of chemical agent that may not be exceeded for any period of time. Practically, it may be an average value over the minimum time to detect the specified concentration.

C11.4. TOXIC CHEMICAL AGENT HAZARD ANALYSES, MEASUREMENTS, AND EXPOSURE CONTROLSC11.4.1. Hazard Analyses

C11.4.1.1. Hazard analyses shall be conducted for all new operations involving toxic chemical agents or when there is a change in existing production, process, or control measures that may result in an increase in airborne or contact concentrations of toxic chemical agents. Hazard analyses shall be retained for 40 years.

C11.4.1.2. If hazard analyses indicate that an operation may expose personnel to toxic chemical agents above the AEL, control measures shall be instituted and procedures shall be established so that the actual exposure is measured.

#### C11.4.2. Measurements

C11.4.2.1. Devices for sampling and analyzing workplace air shall measure and alarm within 10 minutes when toxic chemical agents are present in excess of the 8-hour TWA concentrations.

C11.4.2.2. When the interior of reservoirs, pipes, and such systems are sampled, the volume of the item or system being sampled as well as the volume of the sample must be recorded and associated with the measured concentrations.

C11.4.2.3. Decontaminating solutions shall not be analyzed for residual toxic chemical agent for the purpose of certifying a level of decontamination. Suspected toxic chemical agents shall be extracted from samples with suitable solvents where analyses are required. Air may be an appropriate solvent for volatile agents.

#### C11.4.3. Exposure Control

C11.4.3.1. When exhaust systems are used to control exposure, measurements of system effectiveness such as static pressure shall be made at the start of each operation and at least every 3 months.

C11.4.3.2. Before beginning toxic chemical agent operations, the hazard zone associated with those operations shall be under positive control IAW paragraph C11.2.2.

C11.4.3.3. If personnel exposures will equal or exceed the applicable AEL, personnel shall be protected by personnel protective equipment (PPE) specifically approved by the Army Surgeon General or as indicated in Table C11.T2.

C11.4.3.4. Procedures shall be developed to address hazards involved in maintenance and repair operations.

Table C11.T2. PPE<sup>1</sup> and Employee Exposure Potential<sup>2</sup>

Occupational Scenario	Toxic Chemical Agents (mg/m <sup>3</sup> )				
	GD	GA/GB	VX	H,HD, & HT	L
1. Unmasked agent worker					
A full facepiece, chemical canister, air purifying protective mask will be on hand for escape. (The M9, M17 or M40 series masks are acceptable for that purpose. Other masks certified as equivalent may be used.) (Note 5)	$3 \times 10^{-5}$  (Note 3)	$1 \times 10^{-4}$  (Note 3)	$1 \times 10^{-5}$  (Note 3)	$3 \times 10^{-3}$  (Note 4)	$3 \times 10^{-3}$  (Note 4)
2. Masked personnel in routine operations					
a. A National Institute of Occupational Safety and Health (NIOSH) approved pressure demand full facepiece SCBA or supplied air respirator with escape air cylinder may be used.	$>3 \times 10^{-5}$	$>1 \times 10^{-4}$	$>1 \times 10^{-5}$	$3 \times 10^{-3}$	$3 \times 10^{-3}$
b. Alternatively, a full facepiece, chemical canister, air purifying protective mask is acceptable for that purpose (i.e., M9, M17, or M40 series or other certified equivalent.) (Note 5)	to $6 \times 10^{-2}$	to $2 \times 10^{-1}$	to $2 \times 10^{-2}$		
3. Personnel conducting emergency operations or operations in unknown but potentially high agent concentrations					
a. NIOSH approved pressure demand full facepiece SCBA with protective ensemble. (Notes 7 & 8)	$>6 \times 10^{-2}$	$>2 \times 10^{-1}$	$>2 \times 10^{-2}$	$>3 \times 10^{-3}$ (Note 6)	$>3 \times 10^{-3}$ (Note 6)
b. During emergencies, the best available respiratory protection and personnel ensemble will be used. If protection in 3a above is not available, use of a full facepiece, chemical canister, air purifying protective mask with hood is acceptable. Only the M9 or M40 series masks are acceptable. (Notes 7 & 8)					

Notes for Table C11.T2.:

1. Qualitatively fit all workers required to use respiratory protective devices. Quantitative fit testing may be performed using surrogate masks.
2. Employee exposure potential is based on an 8-hour TWA measurement. All values on this table are 8-hour TWA unless otherwise noted. The TWA is the concentration to which workers may be repeatedly exposed, for

a normal 8-hour workday and 40-hour workweek, day after day, without adverse effects. TWA permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. Excursions above the TWA should be controlled even where the 8-hour TWA is within recommended limits.

3. Determined by required continuous air monitoring.
4. This represents ceiling value determined by continuous real time monitoring (with alarm) at the 0.003 mg/m<sup>3</sup> level of detection. Respiratory protection must be immediately available in case concentration rises above 0.003 mg/m<sup>3</sup>. Engineering and work practice controls shall be used to limit employee exposure potential to the extent practical.
5. Air-purifying masks may not be used in oxygen deficient atmospheres.
6. Because agents H and L are potential carcinogens, the highest level of respiratory and dermal protection shall be provided to all workers exposed. An air-purifying protective mask is not suitable for this purpose.
7. Examples of such protective ensembles include Toxicologic Agent Protective Ensemble, Self-Contained (TAPES) and the Demilitarization Protective Ensemble (DPE).
8. For emergency masked escape, a full facepiece, chemical canister, air-purifying protective mask (DoD Component-certified masks) is acceptable.

#### C11.5. MEDICAL SURVEILLANCE

Before being assigned to toxic chemical agent duties and on an annual basis thereafter, health assessments shall be provided for each employee to establish a baseline health record. Annual assessments shall be used to determine deviations from the baseline.

#### C11.6. WORKER PPE

C11.6.1. Positive engineering and administrative controls shall be incorporated in all operations involving toxic chemical agents to preclude or minimize the need for PPE.

C11.6.2. A respiratory protection program shall be established in conformance with DoD Instruction 6055.1 and DoD Instruction 6055.05 (References (~~adaf~~) and (~~aeag~~)) for approved respiratory requirements. The wearer's face shall be clean-shaven to the extent that there is no interference of any facial hair growth with the sealing surfaces of the protective mask. Personnel with beards shall be denied access to agent storage and operating areas, unless suitable emergency egress respirator(s) can be provided.

C11.6.3. Personnel shall use PPE recommended by the hazard analysis. (See Table C11.T2.)

#### C11.7. ADMINISTRATIVE AND WORK PRACTICE CONTROLS

##### C11.7.1. Containment

C11.7.1.1. Containment is the principal control measure for prevention of exposure of personnel to toxic chemical agents.

C11.7.1.1.1. Total containment is required for those operations involving toxic chemical munitions that contain explosive components when the operation may subject the

explosives components to a potential initiating stimulus. Total containment requires the equipment or facility to be a DDESB-approved design capable of containing all the reaction gases, detectable toxic chemical agents, and fragments from the largest explosion or detonation that could occur without causing equipment or facility rupture or leakage. Operations requiring total containment include, but are not limited to:

C11.7.1.1.1.1. Toxic chemical munition cutting, sawing, milling, drilling, punching, or shearing operations that require the machine tool to remove or displace metal before or after contact with the explosives.

C11.7.1.1.1.2. Operations in which the toxic chemical munition arming and functioning environments can be duplicated by the equipment or process.

C11.7.1.1.1.3. Disassembly of armed or possibly armed toxic chemical munitions.

C11.7.1.1.1.4. Disassembly of explosive components from toxic chemical munitions that requires application of significantly greater leverage or torque than that required for assembly.

C11.7.1.1.2. Vapor containment is required for those operations involving toxic chemical agents without explosives components and for those operations involving toxic chemical munitions containing explosive components that do not subject the explosive components to a potential initiating stimulus. Vapor containment requires the equipment or facility to be a DDESB-approved design capable of containing non-explosion releases of toxic chemical agents. Operations requiring vapor containment include, but are not limited to:

C11.7.1.1.2.1. Toxic chemical munitions punching, drilling, or sawing operations for removal of toxic chemical agents.

C11.7.1.1.2.2. Burster-well removal.

C11.7.1.1.2.3. Transfer of toxic chemical agents from bulk storage tanks, containers, or toxic chemical munitions into holding tanks, chemical detoxification reactors, incinerators, or similar processing equipment (e.g., may be found in a production, demilitarization, or disposal line).

C11.7.1.1.2.4. Research, development, test, and evaluation (RDT&E) chamber operations.

C11.7.1.2. Containment is not required for operations associated with field storage and maintenance activities (e.g., shipping, storage, receiving, re-warehousing, minor maintenance, surveillance inspection, repair, and encapsulation).

C11.7.2. Training and Information. Anyone who works with toxic chemical munitions and agents (e.g., agent workers, firefighters, medical and security personnel) shall receive training to

enable them to work safely and to understand the significance of toxic chemical agent exposures. This training shall include, but is not limited to, information on sources of exposure, adverse health effects, practices and controls used to limit exposures, environmental issues, medical monitoring procedures, and employee responsibilities in health protection programs.

C11.7.3. Recordkeeping. Recordkeeping pertaining to exposure determination and measurement, mechanical ventilation, employee training, medical surveillance, and access to records shall be consistent with Reference (~~aeag~~).

C11.7.4. Labeling and Posting of Hazards

C11.7.4.1. Signs and labels to warn personnel of hazards of toxic chemical agents are required for:

C11.7.4.1.1. Work areas.

C11.7.4.1.2. Contaminated clothing and equipment.

C11.7.4.1.3. Identification of restricted-use areas.

C11.7.4.2. When items or materials are contaminated or suspected of being contaminated with toxic chemical agents, they shall be marked as follows:

C11.7.4.2.1. The applicable supplemental chemical hazard symbol (see Figure C8.F3.) with “XXXXX” indicates that the items or materials have been completely decontaminated and may be released for general use or sold to the general public. Items or materials are completely decontaminated when they have been subjected to procedures that are known to completely degrade the toxic chemical agent molecule, or when analyses, approved by the DDESB, have shown that the total quantity of toxic chemical agent is less than the minimal health effects dosage as determined by the Office of the Surgeon General of the Army.

C11.7.4.2.2. The applicable supplemental chemical hazard symbol (see Figure C8.F3.) with “XXX” indicates that the items or materials have been decontaminated. Tests or monitoring shall be conducted IAW DoD Component requirements to verify that concentrations do not exceed the AEL for an unmasked agent worker in Table C11.T1.

C11.7.4.2.3. The applicable supplemental chemical hazard symbol (see Figure C8.F3.) with a single “X” indicates the items or materials have been partially decontaminated of the indicated toxic chemical agent. Further decontamination processes are required before the item is moved or any maintenance or repair is performed without the use of PPE.

C11.7.4.3. When facilities or rooms are contaminated or suspected of being contaminated with toxic chemical agents, they shall be marked as follows (excluding magazines that use the supplemental chemical hazard symbols shown in Figure C8.F3.):



C11.7.4.3.1. 5R – No Agent Hazard. A supplemental chemical hazard symbol (see Figure C8.F3.) with “RRRRR” indicates that all previously contaminated surfaces are decontaminated and analyzed to demonstrate the absence of residual toxic chemical agents, and air sampling indicates toxic chemical agent vapor concentration is less than the 8-hour TWA for an unmasked agent worker (see Table C11.T1.). The air is sampled at a temperature of 70 °F [21.1 °C] or greater, with the facility’s ventilation system operating.

C11.7.4.3.2. 4R – Controlled Agent Vapor Hazard. A supplemental chemical hazard symbol (see Figure C8.F3.) with “RRRR” indicates that all previously contaminated surfaces are decontaminated using locally approved procedures and air sampling indicates toxic chemical agent vapor concentration is less than the 8-hour TWA for an unmasked agent worker (see Table C11.T1.). The air is sampled at a temperature of 70 °F [21.1 °C] or greater, with the facility’s ventilation system operating.

C11.7.4.3.3. 3R – Contained Agent Hazard. A supplemental chemical hazard symbol (see Figure C8.F3.) with “RRR” indicates that any toxic chemical agents are in containers or packaging which, if left undisturbed, will prevent agent vapor or contact hazards.

C11.7.4.3.4. 2R – Agent Vapor Hazard. A supplemental chemical hazard symbol (see Figure C8.F3.) with “RR” indicates that any toxic chemical agents are in containers or packaging which, if left undisturbed, prevent contact hazards.

C11.7.4.3.5. 1R – Agent Hazard. A supplemental chemical hazard symbol (see Figure C8.F3.) with “R” indicates the possibility of toxic chemical agent contact or vapor hazards, or agents in a single container or packaging that may leak. This includes rooms being used for operations that may cause agents to be released from engineering controls due to accidental causes.

#### C11.7.5. Emergencies

C11.7.5.1. In case of an accidental release of a toxic chemical agent that may result in personnel exposure, all nonessential and unprotected personnel shall evacuate immediately. Contaminated areas shall be decontaminated to applicable Table C11.T1. AEL before normal operations are resumed.

C11.7.5.2. Special medical surveillance shall be started within 24 hours for all personnel present in the potentially affected area at the time of the emergency.

C11.7.5.3. The DoD Component shall maintain up-to-date chemical accident and incident control plans and conduct practice exercises of these plans at least annually.

#### C11.7.6. Toxic Chemical Agent Decontamination

C11.7.6.1. When toxic chemical agents are spilled or released, immediate action shall be taken to contain the spill and clean up the agent in the immediate area of the spill.

C11.7.6.2. Before leaving contaminated work areas, the external surfaces of the PPE shall be decontaminated.

C11.7.6.3. When PPE becomes contaminated with toxic chemical agents, the outside layer of clothing shall be removed and decontaminated as soon as possible.

C11.7.6.4. PPE that has been worn in known contaminated areas (toxic chemical agent detected) shall be decontaminated and monitored before reuse. Because mustard penetrates into many protective materials with time, reuse of any PPE that has been contaminated with liquid mustard is not permitted. PPE that has been worn in potentially contaminated areas (when no agent leakage has been visually observed or detected by use of field detection equipment) shall be monitored before being moved to areas accessible to non-agent workers.

C11.7.6.5. Monitoring of protective clothing and equipment shall include containerization at 70 °F [21.1 °C] or higher for at least 4 hours, with subsequent analysis of a portion of the interior atmosphere of the container for the toxic chemical agent. The volume of the container as well as the sample volume must be noted.

C11.7.6.6. PPE found to emit toxic chemical agent concentrations above the XXX level after decontamination shall not be reused. They shall be disposed of ~~in accordance with~~ IAW DoD Component guidance and in compliance with all Federal, State, and local requirements.

C11.7.6.7. *Before toxic chemical agent disposal systems are converted to different agents*, ~~The~~ piping, tanks, etc., of the disposal systems shall be filled with decontaminating solution and a contact time of 10 half lives or greater shall be provided ~~before toxic chemical agent disposal systems are converted to different agents~~. Walls and floors of process areas shall be decontaminated to ensure the absence of contact hazards.

C11.7.7. Recertification of Protective Clothing. After decontamination, clothing that has been determined to be XXX may be laundered, visually examined, and re-certified by the DoD Component for use. Other PPE, such as boots and gloves, shall be tested, laundered, and re-certified for use in the same manner.

C11.7.8. Transportation of Items or Materials Contaminated with Toxic Chemical Agents. Items or materials contaminated with toxic chemical agents may be transported from one location to another. They shall be encapsulated within an agent-tight barrier. In addition, the following ~~items or materials~~ shall be overpacked in compatibly lined drums or provided with other suitably tested containment before being transported:

C11.7.8.1. *Items or materials potentially* ~~C~~contaminated ~~potentially~~ with liquid toxic chemical agent.

C11.7.8.2. *Items or materials that* ~~F~~failed a XXX determination.

C11.7.8.3. *Items or material* ~~S~~suspected of offering hazards due to skin exposure to a toxic chemical agent.

C11.7.9. Transportation of Toxic Chemical Munitions and Bulk Agents. The requirements established by the DoD Component shall be met.

## C11.8. ENGINEERING DESIGN GUIDANCE FOR FACILITIES

The chemical handling and maintenance areas associated with industrial operations shall be isolated from the main facility and shall be operated at a negative pressure with respect to the main facility area. The agent handling rooms shall be equipped with local exhaust ventilation which may be cascaded to more contaminated areas and exhausted out of a common exhaust stack. All air leaving the facility shall be filtered through redundant filter banks or other DDESB-approved decontamination methods. The flow of air (negative pressures) shall go from less-hazardous areas to more-hazardous areas.

C11.8.1. Air Ventilation Systems. Air ventilation systems shall be designed and periodically tested to ensure that control of toxic chemical agent-contaminated exhaust shall not exceed source emission limits of Table C11.T1.

C11.8.1.1. Filters or scrubbers for exhaust air shall be designed and approved for the MCE of the operations involved.

C11.8.1.2. Redundant filters shall be used when filter breakthrough of the toxic chemical agent is expected. Filters shall be changed when agent breaks through the filter that is just upstream of the last filter.

C11.8.1.3. All exhaust equipment shall have backup blowers that automatically engage if the main blower fails.

C11.8.1.4. Filter systems shall be fitted with the means to measure the pressure drop across the filters.

C11.8.1.5. Exhaust hoods and glove boxes shall be designed to contain toxic chemical agents so that concentrations specified in Table C11.T1. for unmasked agent workers are not exceeded outside engineering controls. The design of these items shall permit airflow adjustments sufficient to maintain the required protection level when laboratory equipment is in place.

C11.8.1.5.1. Catch basins and traps or spill trays of sufficient capacity to contain the quantity of toxic chemical agent involved shall be provided within hoods and glove boxes.

C11.8.1.5.2. Glove boxes shall be used when the hazards analysis indicates that toxic chemical agent aerosols or dusts may be present during an operation.

C11.8.1.6. Special design features shall be used when exposed explosives are involved to segregate explosives from air ventilation systems.

#### C11.8.2. Mechanical and Utilities Design for Facilities

C11.8.2.1. The design parameters shall consider equipment and process layout, makeup airflow, and operational positions with regard to maintaining flow balance and cross currents. The system shall maintain negative pressure in operating areas in relation to hallways, offices, and other nontoxic chemical agent areas.

C11.8.2.2. Working surfaces, walls, floors, and ceilings within a facility likely to be contaminated shall be constructed of agent-resistant materials. Flooring material shall cover wall surfaces to a height of 6 in [15.2 cm].

C11.8.2.3. Access to nontoxic chemical agent areas (e.g., utilities, mechanical rooms, etc.) shall be accomplished without entry into toxic chemical agent areas.

C11.8.2.4. Electrical systems shall be equipped with a backup power source designed to start automatically and supply sufficient power to support critical functions in the event of power outage.

C11.8.2.5. Safety showers and eyewash fountains shall be readily accessible and tested.

C11.8.2.6. Water outlets in a toxic chemical agent operational facility shall be fitted with backflow devices.

C11.8.2.7. Dedicated liquid waste systems shall be designed to collect and hold potentially toxic chemical agent-contaminated effluent produced by the activity until disposal IAW applicable laws. Vents or other openings in the waste system shall be fitted with approved toxic chemical agent filters or connected or exhausted to facility toxic chemical agent air filtration system.

C11.8.2.8. Decontamination facilities of sufficient capacity to catch and contain liquid effluents shall be provided for toxic chemical agent operations. Adequate decontamination solution shall be available for immediate use on personnel or on facilities.

C11.8.2.9. When operations require work assignments to be conducted at exposure levels above or potentially above the AEL for unmasked agent workers (see Table C11.T1.), change facilities with showers shall be provided.

#### C11.8.3. General Design Considerations

C11.8.3.1. Facility Alarms and Monitors for Engineering Systems. Each toxic chemical agent facility shall have a master alarm and control panel that will permit functional verification of the exhaust blowers and air handlers. Visual and audible alert alarms shall be keyed to this master alarm panel to indicate failures.

C11.8.3.2. Fire Detection and Protection. Fire detection and protection systems for production and maintenance facilities shall comply with the requirements and guidelines published in ARLCD-CR-80049 (Reference (~~af~~*ah*)).

C11.8.3.3. Bulk Storage Tanks. Impermeable dikes to hold at least 110 percent of the tank capacity, plus the required volume of decontaminant solution, shall be placed around all bulk agent tanks, reactors, and mixers. However, a system designed to pump the toxic chemical agent from the dikes to a vessel designed to accommodate the decontamination will satisfy this requirement that the dike contain sufficient volume for the decontaminating solutions.

C11.8.3.4. Isolation of Facility Functions. Toxic chemical agent facilities shall be designed to isolate unrelated activities by physical barriers or approved engineering controls. Design criteria shall prevent explosives from entering drain lines and sumps containing toxic chemical agents.

C11.8.3.5. Monitoring. Air monitoring stations shall be established around toxic chemical agent operational areas and storage areas to determine if Table C11.T1. AEL are exceeded. In laboratory environments this requirement is met by routine area monitors and stack sampling.

C11.8.3.5.1. Monitoring analyses conducted for the purpose of demonstrating compliance with AEL shall be based on DoD Component-certified reference materials.

C11.8.3.5.2. Monitoring analyses conducted for the purpose demonstrating compliance with AEL shall be conducted under quality assurance plans that address the following issues:

C11.8.3.5.2.1. Production, characterization, and storage of DoD Component-certified reference materials.

C11.8.3.5.2.2. Documentation of precision, accuracy, and quantification limits of analytical methodology.

C11.8.3.5.2.3. External oversight of laboratory results.